

**Calavera Hills and Robertson Ranch
Habitat Conservation Area**

(Dedicated natural areas set aside as part of the
Calavera Hills Phase II and Robertson Ranch developments)
(CNLM No. S031)

Annual Work Plan

October 1, 2012 - September 30, 2013

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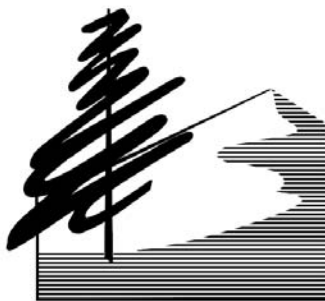
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I. Introduction and Summary

This work plan has been developed from the guidelines for goals and objectives set forth in the Calavera Hills and Robertson Ranch HCA Habitat Management Plan (CNLM 2012a). The Center for Natural Lands Management (CNLM) holds conservation easements (since June 2006 for Calavera Hills Phase II, and February 2007 for Robertson Ranch East Village, and December 2007 for Robertson Ranch West Village Parcel 23C Phase I) on the Calavera Hills and Robertson Ranch Habitat Conservation Area (HCA) and performs or oversees the tasks identified in the HMP.

The HCA is comprised of seven parcels, commonly referred to as Village H, R, U, W, and X, Robertson Ranch East Village, and Robertson Ranch West Village PA 23C Phase I, the first phase of a two phase parcel recordation process. CNLM has merged the funding and reporting for these two areas as we provided the developer a financial discount for selecting CNLM to manage both properties (See Appendix 1 for location maps). This will also simplify future budgetary, reporting, and planning considerations.

The purpose of this work plan is to identify the tasks and budget required to complete the management activities for the upcoming management year that will begin on October 1, 2012 and end on September 30, 2013. Unless otherwise stated, all tasks will be performed by Center's Preserve Manager Patrick McConnell, Regional Manager Markus Spiegelberg, Assistant Preserve Manager Stephen Rink, and ranger Todd Nordness.

Summary of Tasks and Goals for the Management Year:

- Maintain signs and existing fences
- Continue blocking unwanted trails
- Conduct coastal California gnatcatcher (cagn) surveys
- Perform needlegrass grassland habitat assessments in Village H.
- Conduct habitat assessments of thread-leaved brodiaea (*Brodiaea filifolia*), and Wiggins Cryptantha (*Cryptantha wigginsii*)
- Continue monitoring coastal sage scrub (css) long-term monitoring plots
- Continue Village H Partner's restoration
- Monitor and control nonnative, exotic plants
- Continue Village X exotic forb control
- Facilitate exotic forb control in portions of West Village PA 23C
- Involve intern in setting up long-term thatch removal experiment at Village H
- Continue fennel (*Foeniculum vulgare*) and Pampas (*Cortaderia selloana*) control at Village H
- Maintain the habitat restoration project at Village R
- Conduct weekly patrol visits, continue blocking unwanted trails
- Remove trash as necessary
- Conduct conservation easement (CE) compliance
- Prepare and provide to the wildlife agencies and City of Carlsbad an annual report that describes the management activities and information gathered during the management year

- Provide an accounting of funds to be spent in the management year

Appendix 2 (Task Schedule) identifies the approximate schedule of tasks for the upcoming management year.

II. Management Activities

The following sections identify and describe the activities to be performed during the upcoming management year. Based upon the Property Analysis Record (PAR) developed by CNLM to outline long-term management tasks and costs, management activities can be categorized into seven groups: Capital Improvements, Biological Surveys, Habitat Restoration, Public Services, Reporting, Office Maintenance, and Operations. Each of these categories will be discussed below.

A. Capital Improvements

The installation of signs and fences will occur during this management year:

1. **Signing** Signs will be maintained at all of the major access points and along most of the perimeter to the HCA and a few other notable locations. Each sign explains that the HCA is a dedicated as a habitat preserve, and that fire, off-road vehicles use, dumping, and shooting are prohibited.
2. **Fencing** We will continue to block unwanted trails in Village U and elsewhere with anchored vegetation where possible, and continue replacing damaged fence sections when necessary.

B. Biological Surveys

Biological monitoring activities will follow items listed in the HMP. Below is a description of the tasks that will be accomplished during the upcoming management year. In addition, Table 1 outlines all tasks that will be completed and an associated time line for the next 5 years.

Monitoring during the next year will include protocol cagn surveys, needlegrass grassland assessments, habitat assessments for the two rarest plant species that occur on the HCA; and the fourth year of a long-term css monitoring program. CNLM may also begin mapping and performing assessments on lens and other css opening vegetation assemblages. All data will be entered or stored in a Geographic Information System (GIS) database, or in MS Excel. Brief descriptions of monitoring activities outlined by taxa are provided below:

1. Coastal California gnatcatcher surveys

CNLM began a three year interval comprehensive City-wide cagn survey schedule in 2010, and spring 2013 will mark the second year of these surveys. Surveys will include a

minimum of two visits to all suitable habitat. Taped vocalizations will be used as necessary.

2. Sensitive Plants and Vegetation Surveys

- a) **Coastal sage scrub (css) long-term monitoring** CNLM has completed four consecutive years of css monitoring on this and other HCA's in our system. CNLM will continue measuring cover and species richness in a subset of transects during spring 2013. More information about the justification for these plots, and the sampling design is provided in Appendix 3.
- b) **Wiggins Cryptantha habitat assessments** CNLM has not observed San Diego thornmint (*Acanthomintha ilicifolia*) onsite since spring 2010. It is doubtful that the species will be observed at this locality again. Therefore, habitat assessments for this species have been discontinued. However, as per the HMP, a potentially even more rare species has been documented in a couple of localities in Village X, nearby where the thornmint was observed. If time and budget conditions allow, we will perform a similar habitat assessment on Wiggins Cryptantha that was performed on thornmint. Refer to CNLM 2012b for information relating to current known extent of *Cryptantha wigginsii* in Village X. An article relating to this discovery and subsequent known locations has been accepted for publication in the journal Madrono.
- c) **Thread-leaf brodiaea sentinel plots** CNLM has developed a strategy to sample representative localities of thread-leaf brodiaea (TLB) that involves vegetative and flowering counts, as well as species richness, in sub-samples of representative occurrences throughout our preserves. The goals and rationale for this program are available in Appendix 4. These monitoring activities will occur in the spring of 2013.
- d) **Lens and other herbaceous opening assessments** This is an optional task, dependent upon whether other tasks are accomplished, and if time and/or funds are adequate to carry out one or more of these assessments. CNLM will identify several areas that will receive long-term attention to monitor for threats like purple falsebrome (*Brachypodium distachyon*), habitat degradation through human usage, or other edge effects. Among these areas will obviously include the localities where species like Wiggins Cryptantha occur, but we may also identify one or more openings that house typically dense assortments of mosses (*Selaginella* spp.) and liverworts (*Asterella* sp.), and typically also contain annual herbaceous flowers such as chia (*Salvia columbariae*), golden-ray pentachaeta (*Pentachaeta aurea*), and tidy tips (*Layia platyglossa*), among others. Typically, the soils tend to be composed mostly of clay. Although such local assemblages may have lacking information as to their functional importance, and make up a small percentage of the total land-cover among our preserves, they appear under threat of disappearance. Good examples of areas that appear healthy are the clay soils along the edge of chaparral habitat in the eastern parcel of Village K. Some of these openings offer colorful wildflower displays late into each spring season, and therefore potentially serve as pollen and nectar sources for native Dipteran and Hymenopteran insects. Other openings like this exist in almost every parcel in this HCA, but some appear to be nearing

invasion by non-native grasses and/or forbs. In this and subsequent years CNLM will work towards identifying cohesive locations like these on GIS by marking boundaries and noting nearby threats using the template provided in Appendix 5. Thenceforth, we will visit locations annually: noting threats and implementing habitat maintenance in cases where habitat quality is in decline and manpower or financial circumstances allow.

Table 1. Schedule of Biological Monitoring Tasks

Monitoring Type	HMP description Section	2013	2014	2015	2016	2017
CSS Monitoring*	C.1 Method 1					
Grassland Assessments*	C.1 Method 1.2					
Vegetation Mapping*	C.1 Method 2					
Lens/ other herbaceous mapping & assessments	C.1 Method 3					
Wiggins Cryptantha Habitat Assessments	C.2 Method 1					
Thread-leaf Brodiaea repeat visit Plots*	C.2 Method 2					
Thread-leaf brodiaea thatch removal experiment	C.3 Method 3			TBD	TBD	TBD
Grapplinghook, Small-flower Microseris Assessments	C.2 Method 3			TBD	TBD	
Western Dichondra Assessment	C.2 Method 4					
California Adolphia Assessment	C.2 Method 4					
Cagn Surveys*	C.3 Method 1					
San Diego Horned Lizard scat sampling*	C.3 Method 2			TBD	TBD	
Ant Sampling*	C.3 Method 3			TBD	TBD	

Gray indicates the year when surveys/assessments should be performed

* Indicates tasks that must be done, while those tasks without an asterisk are to be carried out if **budget permits**

C. Habitat Restoration and Maintenance

Most of the HCA's habitat is good quality, with little disturbance from nonnative plant species. There are nonnative exotic plants scattered throughout the HCA, however. CNLM has budgeted for continuing the eradication efforts in Village H, X, and Robertson Ranch parcels.

1. **Village H weeds** Fennel, crown daisy (*Glebionis coronarium*), artichoke thistle (*Cynara cardunculus* ssp. *flavescens*), and Bermuda-buttercup (*Oxalis pes-caprae*) patches will continue to be controlled in this area of the HCA. Two five-man contractor crew days (ccd's) have been budgeted for fennel and other weeds along the northern portions of Village H, and three days have been budgeted for the Partner's restoration along the southern third of Village H.
2. **Village H dethatching** The budget remaining for habitat maintenance was quite full this management year, and therefore, despite Table 1 indicating that this task is intended for 2013-2014 management year, CNLM is considering utilizing crews this management year for removing thatch among the thread-leaf brodiaea sites. At a minimum, we intend

on utilizing an intern and Pacific Ridge School in carrying out at least a portion of this task. The experimental design is not completed, but the idea is that each thread-leaf brodiaea population have thatch removed from half or more of current distribution. Other areas of the needlegrass habitat in Village H are also to receive thatch removal and Fusillade treatments. Fusillade will not be applied in the immediate surroundings or within occupied brodiaea sites.

3. **Robertson Ranch and Village X weeds** Crews will again be utilized at least once this spring to continue the removal of black mustard (*Brassica nigra*), bristly ox-tongue (*Helminthotheca echioides*), and other weeds along the western areas of Village X parcel. This area holds much promise, as it surrounds thread-leaved brodiaea localities, and has many small-flower bindweed present that may continue increasing density. Native shrubs are also colonizing the openings. Two crew days have been budgeted for this parcel.
4. **Village R restoration** Village R is re-vegetating very well, mostly by way of natural recruitment of native shrubs and grasses. We will be applying herbicide and manually weeding during the 2012-2013 management year, as needed. As with spring 2012, there will likely only be one treatment during late spring, consisting of a four man crew for half a day.
5. **West Village and East Village re-vegetation** CNLM will continue to work with developers and assigned contractors to ensure that faithful compliance with re-vegetation plans is carried out and that pertinent documents are made available wherever possible. The remainder of PA23C that was planned to be restored is currently in the early stages of restoration, and we will be helpful to contractors responsible for the restoration areas whenever possible.
6. **Village H restoration** CNLM has received matching funding through the Partner's for Fish and Wildlife program to restore an approximately 5-acre portion at the southern end of Village H. With the help of Pacific Ridge School, CNLM has directed the planting of approximately $\frac{3}{4}$ acre of this area with css species. Irrigation was installed using a drip irrigation system. CNLM will continue to utilize Pacific Ridge School and one or more interns in this endeavor during the 2012-2013 management year.

D. Public Services

Public services activities include the patrols and enforcement; consulting with neighbors, HOA representatives, and landscapers about perimeter landscaping; and responding to emergencies. However, other opportunities for public service will undoubtedly be forthcoming during the year with local groups and individuals interested in volunteering labor for HCA projects, and class field trips from local schools. Whenever possible, management will try to accommodate these activities.

1. **Outreach** The landscaping bordering the HCA is typically high-water use. The result of this hydrophilic vegetation is excess water seepage into HCA edges, which will replace dry-adapted vegetation with wetland vegetation, and favors the establishment of weeds.

CNLM has worked with HOA representatives and landscapers regarding this matter, and there has been remarkable improvement. We will continue to work with the HOA's bordering the HCA to ensure that weeds like pampas grass and physical issues like excess water and littering are dealt with promptly.

3. **Patrols** Patrols will be performed approximately four times per month, and also during biological surveys or other HCA activities. Patrols include the routine maintenance of fences, signs and trash removal. Observations of sensitive species, negative human effects, new weed infestations, and trash will be gathered during patrols as well.
4. **Emergency Response** Staff time has been allocated from the current budget for response to emergencies on the HCA. Such emergencies could include response to wildfires, wildlife problems reported by neighbors, and trespass issues.

E. Reporting

Reporting requirements include the management database/GIS system, the photo-documentation stations, and the production of various status reports to the City of Carlsbad, USFWS, CDFG, and CNLM administration.

1. **Database/GIS Management** Data derived from routine patrols and photo-documentation will be entered into and maintained in the HCA's existing database/GIS system. Additional databases will be established for the various biotic monitoring programs including the production of historical and current vegetation maps. Efforts will be made to coordinate and standardize database fields and parameters with other HCA's.
2. **Photo-documentation Stations** Permanent photo documentation stations were established for the Calavera properties in 2006 and photographs were labeled and stored. Photographs at these stations will be updated in 2012, as necessary. Baseline photo points were established for Robertson Ranch West Village PA 23 C Phase I parcel along with Robertson Ranch East parcels during the summer 2008.
3. **Reports**
 - a. **Year-End/Agency Reports** A year-end report will be prepared by the HCA manager by December of 2013 detailing the results of the year's management activities. This report will include recommendations for the continuation of various activities for the following management year and will be submitted to the City of Carlsbad, USFWS, and CDFG, as required under permit reporting conditions.
 - b. **Annual Work Plan** The annual work plan for the 2013-2014 management year will be formulated by the end of the 2012-2013 management year and will be based upon experiences during previous years' operations. This work plan will be submitted to the City of Carlsbad and USFWS and CDFG.

- c. **Conservation Easement (CE) Compliance** The HCA Manager will monitor compliance of all areas of the Conservation Easement to ensure the conservation values are maintained in perpetuity. This process insures CE's are being managed appropriately, and ensures continuity of process. Compliance visits are to be carried out during the later portion of the management year. The next management year will encompass the seventh CE Compliance visit cycle for Calavera Hills parcels, and the fifth CE Compliance visit for Robertson Ranch parcels. All parcels are included in the same annual CE compliance since the 2008-2009 management year.

F. Office Maintenance

HCA management will maintain offices in an organized manner to facilitate maximum efficiency. This section of the budget includes outlays for general office work, utilities, and telephones, among other items/tasks.

G. Operations

Operations include the training and professional growth of Center personnel, and inspection of the HCA by Center administration. Funds have been allocated in the current budget for the HCA Managers to attend classes or seminars during the upcoming year. Also included within this category of activity is the conduct of employee reviews.

III. WORKLOAD AND BUDGETS

1. **Supervision and Staffing:** The Regional Preserve Manager will be supervised by CNLM's Director of Conservation Science, Dr. Deborah Rogers. Tasks and hours will be coordinated by the Regional Manager and approved by Dr. Rogers. The Regional Preserve Manager, Markus Spiegelberg, will supervise the HCA Preserve Managers and Rangers.
2. **Budgeting:** A budget of \$71,815 has been allocated for this management year. Every effort will be made by HCA Management to allocate time and expenses according to this estimated budget.

IV. REFERENCES

CNLM. 2012a. Calavera Hills and Robertson Ranch Habitat Conservation Area Habitat Management Plan 2012 - 2017. September 2012.

CNLM. 2012b. Calavera Hills and Robertson Ranch HCA Annual Report. October 2011-September 2012.

V. APPENDICES

Appendix 1
HCA Location Maps

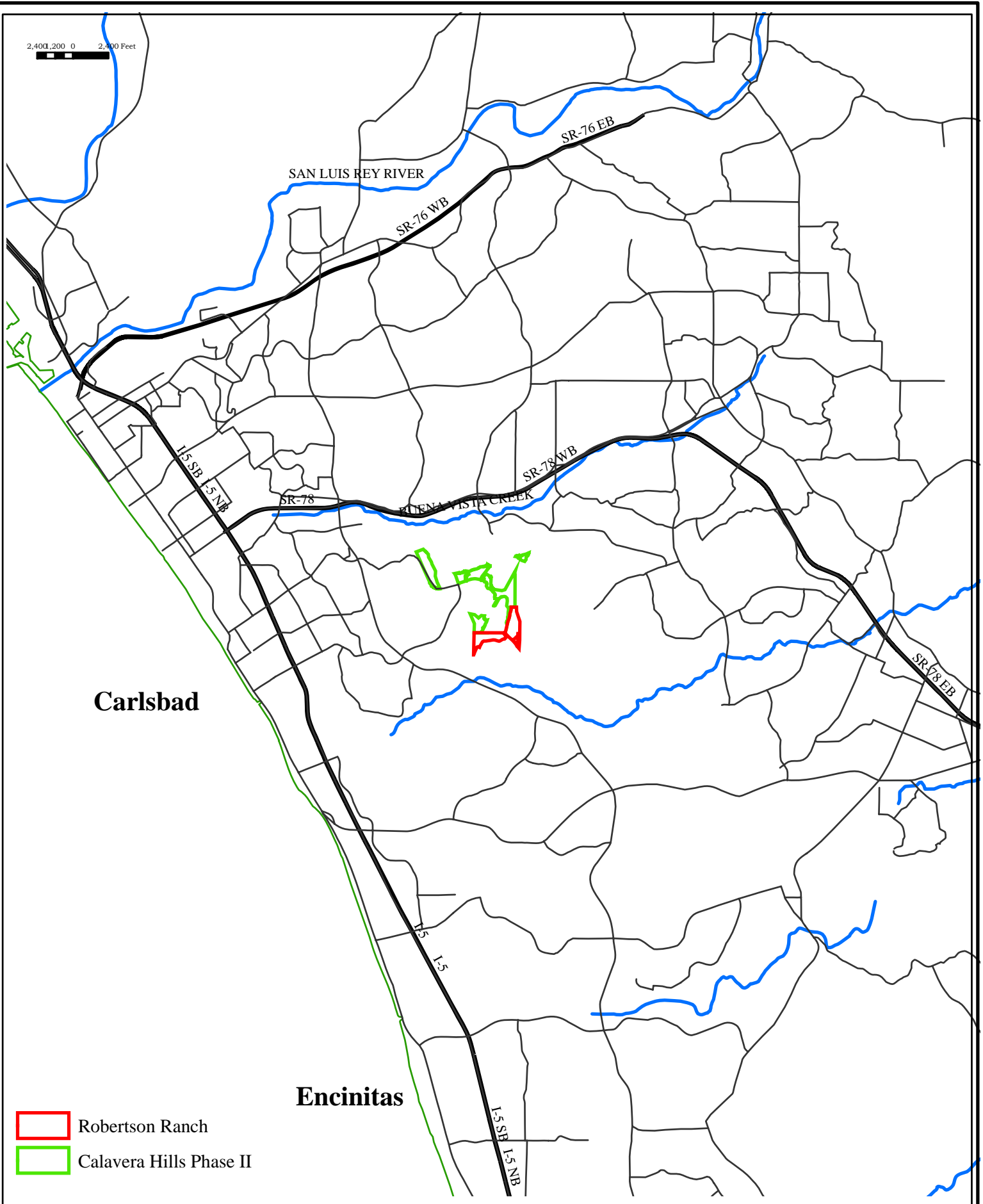


Figure 1
Preserve Vicinity
Robertson Ranch and Calavera Hills Phase II Habitat Conservation Area - Carlsbad, CA



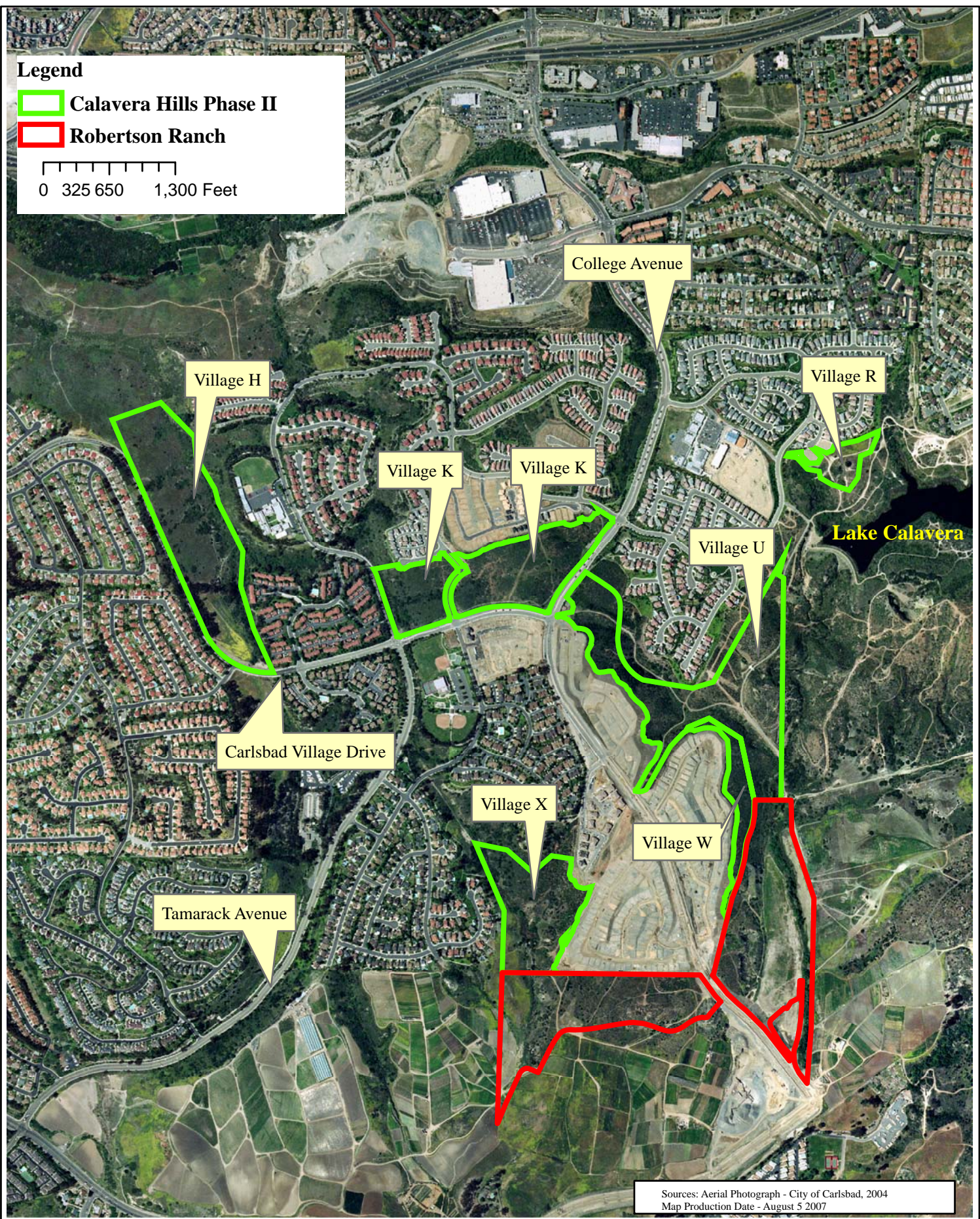


Figure 2
Preserve Location Map
 Calavera Hills Phase II and Roberston Ranch - Carlsbad, CA



Appendix 2. Task Schedule

Task	October- December 2012	January- March 2013	April to June 2013	July to September 2013
Sensitive Plant Habitat assessments			X	
Coastal Sage Scrub Monitoring			X	
Village H native grassland transects			X	
GIS/Database				X
Identify and GPS lens and other openings considered spatially restricted			X	
Village R Restoration	X	X	X	X
Village H Restoration	X	X	X	X
Nonnative Plant Removal (Including contractors)		X	X	X
Thread-leaf brodiaea dethatching in Village H	X			
Fencing/Signage/Trail Blocking	X			X
Patrolling	X	X	X	X
Reports & CE Compliance				X
Position Paper			X	X

Appendix 3
Coastal Sage Scrub Long-Term Monitoring Plan

The Center for Natural Lands Management-San Diego: Coastal Sage Scrub Monitoring Plan

Objective: Track the changes in structure and composition of the coastal sage scrub (CSS) community.

- a. Use data to evaluate the structure and composition of the CSS vegetation community and its correlation to predictions of vegetation changes based on theories postulated by ecological and threats models.
- b. Use data to evaluate changes or trends in “populations”, presence/absence and/or occupied/unoccupied habitat of sensitive animal species, primarily the coastal California gnatcatcher (*Polioptila californica californica*)(CAGN).
- c. Use data to evaluate changes in species richness.
- d. Use data to evaluate changes over time from a baseline vegetation pattern.
- e. Use data to guide vegetation management decisions (i.e. nonnative plant removal, rare species range increases/introductions).

Background of Need:

The Center for Natural Lands Management (CNLM) manages several thousand acres of CSS in San Diego County. These areas host many threatened, endangered and sensitive plant and wildlife species, provide for wildlife movement and are some of the last remaining stands of CSS in coastal San Diego. These areas were also specifically designated as important areas to conserve under the regional Habitat Conservation Planning (HCP) conservation efforts.

As a result, the CNLM needs to be able to evaluate recruitment and vigor of this vegetation community over time to guide management decisions and to evaluate changes in plant and animal communities. This monitoring will also provide an opportunity to evaluate theorized predictions of changes in vegetation communities resulting from urbanization, nonnative species invasion, global warming, increased edge, altered fire regime and fragmentation (to name a few).

Background of Ecological Model and Threats

CSS is a fire-adapted vegetation community with fires occurring naturally, but most severely under the extreme Santa Ana heat and winds of late summer and fall and during drought conditions. During these conditions there would generally be a “complete burn” where all above ground vegetation within the fire’s path would be consumed. After such a fire, herbaceous plants (fire followers), which are known to sprout after fires, would dominate the landscape for a few years. Over time (3-5 years) the shrub lands would regain their dominance, and after 5-10 years a mature assemblage of plants and wildlife would again be found on site (Dallman 1998).

The fire frequency in CSS is as frequent as chaparral due to the volatile oils and resins that occur in CSS plants. The plants, such as white sagebrush (*Saliva apiana*), are able to resprout after a fire or produce many seedlings from the dormant seed bank that lies in the soil. Seed germination of some species may also be stimulated by fire (Holland and Keil 1995, Dallman

1998). However, if the fire frequency and intensity are too great, plants in the CSS community, such as black sage (*Salvia mellifera*) and California sagebrush (*Artemisia californica*) are permanently killed and can no longer regenerate, slowly converting the CSS community to a nonnative, annual grassland (Southwest Division, Naval Facilities Engineering Command 1998).

Each CNLM preserve in San Diego has a different fire history and a different predicted fire future. For example, most of the Rancho La Costa (RLC) Habitat Conservation Area (HCA) burned in the Harmony Grove fire in October of 1996, while the Manchester HCA has not burned (except two very small fires) in its entirety since 1917. Prior to 1917 no data are recorded, so it is uncertain as to when the last significant fire event occurred in the Manchester HCA.

Regardless of fire history and the current vegetation characteristics, there are many realized or potential threats to the integrity of the CSS vegetation community (See RLC Habitat Management Plan CSS Ecological Model and Threats Section (CNLM 2005) that need to be evaluated including:

1. What is the effect of an altered fire regime at each HCA?
2. What is the potential effect of global climate change?
3. What are the effects of urban edge?
4. What are the effects of fragmentation and isolation?
5. What are the effects of altered wildlife usage patterns?

The answers to these threats questions lead to other questions that are associated with effects on ecological processes and patterns, such as:

1. Are the variables investigated representing a threat?
2. At what spatial scale are the variables representing a threat?
3. How do the effects of the threats listed above effect the distribution and abundance of sensitive plant and wildlife species?
4. How do the threats listed above effect the distribution of non-sensitive plants and animals?
5. How do the effects of each threat alter ecological processes?
6. How do the various measured factors interact?

Predictions

Fire. We predict that as a result of fragmentation, complete burns of preserves are now less likely and that there will be fewer, smaller fires resulting in a mosaic of CSS with various age structures.

Global Climate Change. We predict that rainfall patterns will change (likely decrease) over the next 100 years resulting in a lengthening of the fire season, increased frequency of lightening fires, increased frequency of drought, and areas burned. We predict:

1. Possible regime shifts (altered abundance and recruitment patterns in various native vegetation assemblages)
2. Altered invasion severity of exotic species due to changes from native-adapted variations in weather phenomena
3. Lowered native seedling survival of species due to changes from native-adapted variations in weather phenomena
4. Lowered seed and/or clonal production of future generations due to changes from native-adapted variations in weather phenomena
5. Negative interactions between native wildlife and changes resulting from the above mentioned predictions in vegetative cover

Habitat Fragmentation and Urban Edge. We predict that habitat fragmentation will reduce plant diversity and migration and/or genetic exchange between plant populations. This could affect the CSS community by reducing vigor within populations and eventually leading to extinctions of specific plant species.. Habitat fragmentation has resulted in an increase of urban edge on all our preserves. We predict that this will result in increased pressures from nonnative plant species, illegal vegetation clearing, dumping, erosion, and other threats that will change the vegetation structure and composition.

Monitoring Methodology

Approximately fifty plots will be established inside three of our preserves, and the number per preserve allocated by the amount of acreage currently occupied by CSS in each preserve. These plots will be placed in a stratified random manner across our preserves. Stratification will take into account:

1. Size of preserve
2. Slope and aspect
3. Distance from preserve edge/urban edge
4. Presence or absence of CAGN or San Diego horned lizard (*Phrynosoma coronatum blainvillii*)
5. Fire history

Plot Design and Setup

The plot design will be of a modified Whittaker nested vegetation sampling design as in Stohlgren et al. 1995. The dimensions of the macroplot will be 50 meters long by 20 meters wide. Three smaller nested plots will be placed inside the macroplot. The larger of these three is to be 20 meters long and 5 meters wide, placed in the center of the macroplot, with the long axis corresponding to that of the macroplot. The two other nested plots will be at opposite corners of the macroplot, and will be 5 by 2 meters in length, again with the long axis corresponding to that of the macroplot. The design of the modified Whittaker plot we are using deviates from that described in Stohlgren et al. 1995 by not including the 12 smaller 1-square meter rectangles. The long axis of the modified Whittaker plots will be set to cross the environmental gradient present at the macroplot location. Sampling will be carried out for both continuous variables (percent cover by species) and non-parametric and semi-continuous variables (count of dead shrubs, species richness).

Point Intercept Data (Percent Cover)

Percent cover by species will be gathered by running a point-intercept transect along the upper border of each macroplot. The point-intercept transects will be measured at half meter intervals, thus generating 98 “hits” along the long (50 meter) side of the macroplot. Living plants will count as a point or “hit,” if a 1.5 millimeter dowel is intersected in the vertical plane by the living tissue of a plant. At each half meter, data pertaining to bare ground, rock, or litter incident with the dowel will also be collected. Dead branches attached to a living shrub do not count as a “hit.” If a completely dead shrub is incident to the dowel along the point intercept line, that shrub is noted by species (if possible) in a separate column from living plant “hits.” The hope is that this may generate information pertaining to large-scale shrub die-off, as has been recently noticed, but had gone quantitatively undocumented in the Rancho La Costa HCA.

Species Richness

Information gathered inside the smaller sub-plots located inside each macroplot will include species presence. Each species occurring within the sub-plot is recorded. Plants are identified to species and subspecies whenever possible.

We obtained shrub counts in our plots during our first year of sampling ($N = 17$ macroplots), and found that any counting inside subplots in addition to noting species richness cannot be supported on our HCA endowments. Collecting species richness in these subplots is the most time-consuming portion of each visit.

Sampling intensity

CNLM met with Dr. Douglas Deutschman at San Diego State University to inquire into methods of maximizing our return from our effort. We could not afford to monitor more than approximately 20 macroplots per year. Also, the effects of trampling could mislead our conclusions about trend over time if we re-visited the same sites every year over the course of many years. It is necessary to capture the yearly variation in conditions such as rainfall and temperature, and therefore we knew that many replicates would be needed in order to capture meaningful patterns.

Dr. Deutschman suggested a “rotating panel” approach. This approach incorporates visiting a subsample of all macroplots on a yearly basis, ensuring to balance the replicates according to aspect and to spread these replicates across the landscape in order to capture variation in weather or rainfall that may take place across our sample region. It was suggested that we re-visit eight macroplots over the course of three years, while rotating 12 or more new macroplots over the course of the three years. Therefore, after the third year of sampling, roughly 50 plots have been visited, and the variation in measures among the eight re-visit macroplots can be compared to the rotating macroplots. In this manner we can judge if yearly re-visits are necessary in the long-term, or if more sites are needed each year.

For instance, one potential outcome is that the region in which we are sampling does not vary substantially in factors influenced by weather or disturbance, and that by stratifying sub-sampling across the region and visiting a subsample of the whole, we can adequately capture the variation in vegetative and species richness measures without overtaxing our annual budgets. Another potential outcome is that we will obtain substantial information from this rotating panel design to indicate how many more sites should be visited on a yearly basis to capture the yearly variation without visiting the entirety of our plots.

Rational for a Two-Tiered Approach

The data collected in the macroplot, and smaller sub-plots will be useful in generating species area curves and (more importantly) in documenting species presence or absence, as well as recruitment and mortality over time. The advantages of using a multi-scaled approach to quantifying species richness are identified in Stohlgren et al. 1995. As the years progress, small changes in species presence or seedling recruitment may be observed as disappearances, appearances, increases, or decreases on the micro-scale of sub-plot. The appearance of nonnative species may be quickly identified on the macroplot scale, while the disappearance or lack of recruitment among native shrubs may be apparent on the smaller plot scale prior to any notice of change on the macroplot scale.

The point-intercept transect measures will provide a method of quantifying change in abundance by species and edaphic cover which may also tie into species richness changes observed within the sub-plots. For instance, nonnative grasses and/or litter cover changes may be predictive as explanatory variables in a multi-factorial analysis of the response variables mortality or species decline. Other variables that may be tied into a model explaining the measured pattern may include regional rainfall totals for the season and/or seasonal temperature averages, slope and aspect of macroplots, fire history, and the presence or absence of animal herbivory.

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Appendix 4. Thread-leaf Brodiaea (*Brodiaea filifolia*) Monitoring Plan

Center for Natural Lands Management Thread-leaf Brodiaea (*Brodiaea filifolia*) Monitoring Plan

I. Background

Thread-leaf brodiaea (*Brodiaea filifolia*) (TLB) is a federally listed as threatened species and California State listed as endangered. TLB occurs on three Center for Natural Lands Management (CNLM) Preserves and one California Department of Fish and Game (CDFG) Reserve. CNLM-owned or managed preserves include Rancho La Costa (RLC) (The Greens parcel), Village H of Calavera Hills/Robertson Ranch (Calavera), and Carlsbad Oaks North (CON). The CDFG Reserve is Buena Vista Creek Ecological Reserve (BVCER). CNLM owns RLC and CON and manages via Conservation Easement the Calavera Preserve and the BVCER. CNLM is required to monitor TLB populations per the Multiple Habitat Conservation Program (MHCP) Monitoring and Management Plan (CDFG, USFWS, & CBI, 2003).

TLB is a corm bearing species and many TLB occurrences and thousands of TLB individuals are distributed in both a clumped and patchy nature throughout the non-native grassland habitats on CNLM owned or managed preserves. As such, annual TLB flowering response varies drastically depending on weather, site conditions and site location making population counts and estimations difficult and in many cases, inaccurate. Additionally, CNLM would not be able to directly count all of the TLB known to occur on RLC due to the large population, and simply counting these individuals would not benefit TLB in the long run. Population estimations for large rare plant populations, such as TLB on RLC, could also yield unreliable trend information (McEachern and Sutter, 2010). The proposed trend within the MSCP for monitoring large, rare plant populations, that are difficult to count or sample, is to develop an “index of population and habitat condition that can be repeated over many years with the goal of showing the long-term range of natural fluctuation within which conservation management must operate” (McEachern and Sutter 2010). This can be achieved by distributing permanent “index plots” in occupied rare plant habitat (McEachern and Sutter 2010).

CNLM has been monitoring the TLB occurrence on RLC since 2005. Monitoring began on Calavera Hills/Robertson Ranch, Carlsbad Oaks North, and BVCER mostly since 2007. Monitoring has included direct population counts and estimations and habitat assessments. A research project testing the effects of weed management techniques on TLB and nonnative grasses was also initiated in 2006 at RLC (CNLM 2010).

II. Purpose and Objective

Purpose

At RLC, several large TLB occurrences were included in the monitoring and/or weed management research project (CNLM 2010); however, many TLB patches and many TLB plants in other portions of RLC were not included in either the annual monitoring or research project because the research project required copious amounts of time. No time was left to monitor the remaining TLB patches; although these patches were visited each year and in some cases, direct flowering counts were conducted. Additionally, a method to track attribute information in other TLB patches on CNLM preserves was also needed. This method should also be used to establish baseline habitat conditions and to track change within occupied TLB habitat over time. CNLM has decided to use index plots, as described in McEachern and Sutter (2010a) to monitor the TLB occurrences on CNLM owned and managed preserves. The Index Plot method is not intended to estimate population density, but rather, to track annual variation in both vegetative and flowering production over time and relate these data to environmental variables for modeling purposes.

Objective

Track the vegetative and flowering density, species richness, and cover among TLB patches on CNLM preserves using subjectively placed monitoring index plots. Additionally, identify observed or potential threats (i.e., soil saturation, soil erosion, anthropogenic impacts) within or adjacent to each Index Plot. Use this information to identify environmental correlations within TLB occurrences, track occupied TLB habitat changes over time, and to inform management decisions for occupied TLB habitat on all CNLM owned and managed preserves.

III. Methods

Install permanent monitoring plot indices in pre-determined TLB patches on CNLM owned and managed preserves. Preserve Managers can subjectively choose the index plot locations based on the distribution and density of known TLB patches. TLB patches to be targeted should include a diverse range of site conditions, including sites in the northern CNLM-managed preserves and sites in the south; sites that are closest to developed areas that are subject to edge effects (e.g., supplemental irrigation from landscaped slopes); sites that are spatially distributed on upper and lower slopes; and sites that are composed of different dominant plant species. For example, three Index Plots would likely suffice at the RLC HCA based on TLB geographic patch distribution. A smaller number of Index Plot general locations will likely suffice for Calavera and BVCER because these locations aren't as spread out or dense as at RLC.

Complete counts within each Index Plot should be collected on an annual basis until such time that a model may be developed that suggests maximal conditions for assessing population status. Plots will continue to be assessed annually for cover estimation (visual only) by species, and species richness. Annual counts should occur until the locations and annual counts are numerous enough to build a model that is predictive of best rainfall and temperature conditions for complete counts of either vegetative and/or flowering.

1) Index Plot Size and Locations

Index Plot size and location will vary based on the distribution and density of TLB. The index plots have been, and will be subjectively placed to ensure that TLB is located within each Index Plot. Each index plot shall be placed to capture the most TLB present in that patch. For example, if TLB is distributed in a band that is perpendicular to the slope on which it occurs, then the Index Plot will also be placed perpendicular to the slope making sure to capture the majority of the TLB in that patch. Each index plot will receive its own unique identification number, or name beginning with the Preserve name or acronym followed by the number within that preserve; then the frame count within that site. For instance, at Calavera Hills Village H location already installed, and working one's way downhill, the first frame location will be Calavera1TLB1, and continued in this manner. As an additional site is expected to be installed, this will be Calavera2TLB1, 2, etcetera.

1a. RLC

The size and shape of index plots at RLC and CON will vary, depending on previous survey efforts and the size of the localities under study. For RLC, two 4 x 10 meter plots that are part of each experimental unit should be sampled so that counts can stay consistent with previous efforts. The third Index Plot will be subjectively placed in the large occurrence west of Goldstone St., to the north of the SDGE access road, as indicated on Figure 1.

1b. Calavera, CON, and BVCER

The Index Plot sizes at Calavera, CON, and BVCER will be smaller due to the fact that these TLB populations cover a much smaller extent. The number of index plots and the size for each of these two preserves has already been determined by the Preserve Manager. At Calavera Village H, five locations were determined for individual sampling frames of ½ x 1 meter size. Carlsbad Oaks North received smaller frames of 4 x 5 decimeters, since the patches are quite small at this location. The same quadrat size of 4 x 5 decimeters was also used at the BVCER location in 2012, and this site is set up differently due to the density of this population and the small size. Vegetative and flowering counts have been collected at these locations. However, it is expected that another location at Village H will receive another series of quadrats, and/or possibly a location at Village X.

2) Permanent Identification of the Index Plot

At the Village H, and CON locations, opposite corners of each sampling frame were marked by rebar. BVCER has only one dense population, and this population (not yet proven to be TLB) has had a rectangle installed around it, so that a regular array of 4 x 5 decimeter meter quadrats could be used. In the case of the belts at RLC, the index plots are already permanently marked on each corner with rebar. Mason string, or a tape measure can be used to delineate the boundaries of these index plots for the purpose of performing counts. All four corners of each index plot at RLC

will be marked using a hand-held Geographic Positioning System (GPS), the center of each sampling frame at the other preserves will be GPS'd, and maps will be made using an aerial photograph so that surveyors can find the index plot in future surveys.

3) Density

Within each quadrat at Calavera Hills and at CON, a total count of all vegetative and flowering TLB will be collected every year. Vegetative counts will occur in late January/early February and flowering counts will occur in mid-May. Identify what a TLB individual is (i.e., Large (adult) vegetative TLB usually have 3-5 overlapping leaves. Small (young) TLB usually only produce one or two small leaves that are usually not overlapping). Rules for which plants will be counted and not counted will be established. This includes edge rules for whether or not a TLB plant will be counted if it falls directly under the index plot boundary edge so that future biologists can count within the same index plot boundaries using the same rules. For example, count all individuals that are rooted within the index plot.

For RLC, the following explains the reasoning, choice of, and method of reliably counting tlb:

Belts had to be chosen based on whether they were hit by broad-spectrum herbicide during late spring 2012 by ACS Habitat Management, Inc. Ideally, control belts would have been the maximal belts from which to continue counting in. Based on experimental results from the previous four years of applicable data, during the 2012 season, only herbicide and control belts were counted. However, in both macroplot 1 and macroplot 3, most control plots received some herbicide application over TLB, and henceforward, counts based in these plots will no longer be representative of natural variability. Only one control belt was left untouched in each macroplot. In macroplot 1, only belt 10 (control) was unaffected by herbicide application. Therefore, to keep some balance among those continuing counts, one control and one herbicide belt was chosen in each macroplot in order to continue counts. The counting method will continue with a flip-flop of vegetative counts, and to remain comparable to previous year's counts for RLC, these will need to be multiplied by two. Following this, in the late spring, all flowering within the belt will be counted. The following lists the beginning points utilized throughout the experiment for gathering vegetative counts, as one faces in the direction indicated:

Macroplot 1, belt 10, Control: facing south, start between zero and one on the right hand side of belt, with the long axis of a $\frac{1}{2} \times 1$ meter quadrat facing away from the observer

Macroplot 1, belt 5, Herbicide: facing south, start between zero and one on the right hand side of belt, with the long axis of a $\frac{1}{2} \times 1$ meter quadrat facing away from the observer

Macroplot 3, belt 12, Herbicide: facing north, start between zero and one on the left hand side of belt, with long axis of a $\frac{1}{2} \times 1$ meter quadrat facing away from the observer

Macroplot 3, belt 14, Control: facing north, start between zero and one on the left hand side of belt, with long axis of a $\frac{1}{2} \times 1$ meter quadrat facing away from the observer

IV. Works Cited

CBI, 2003. MHCP Biological Monitoring and Management Plan. Prepared by CDFG, USFWS and Conservation Biology Institute. March, 2003.

CNLM. 2010. Annual progress report for the herbicide application of Fusillade II to thread-leaf brodiaea (*B. filifolia*). Research Permit 08-01-RP.

McEachern, K. and R. Sutter. A core monitoring protocol for rare plants in the San Diego Multiple Species Conservation Program. Technical report for Contract 08W3CA5001030 between the U.S. Geological Survey and the San Diego Association of Governments. USGS-Channel Islands Field Station Administrative Report 2010-02.

Appendix 5. Lens and other opening monitoring template

Clay lens, spike-moss, lichen and/or liverwort dominated herbaceous opening data sheet

Date:	Initial visit <i>circle</i> : Yes No	Visitation count (if subsequent to initial visit):
Unique site ID: Include Preserve code followed by parcel ID if applicable, followed by unique number	Boundary mapped this visit? <i>Circle</i> : Yes or no	
Site Type <i>circle</i> : Clay lens, spike-moss, lichen/liverwort	Drought year during this survey? Yes or No	
Plot center <i>if boundary not mapped</i> → UTM E: UTM N:	Polygon ID: Include site ID and file name as recorded in GPS unit	
Photo 1 location: Note position with respect to opening, height from ground, and azimuth of frame	Photo 1 file location and file name:	
Photo 2 location: Note position with respect to opening, height from ground, and azimuth of frame	Photo 2 file location and file name:	
Sensitive spp. present? <i>Circle</i> : Yes No	Sensitive spp.:	
Threat 1:	Threat 2:	
Invasive spp. present in opening? Yes No	Invasive spp.	

Life form (Lichen, moss, spike moss, grass, forb)	Species	Total Cover (whole percentage)	Relative cover
Action needed? Yes No		Reason:	
Recommended action, if needed:			
Action taken? Yes No		Date of action:	

Photo 1

Photo 2